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International telecommunications demand

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ABSTRACT

The means by which consumers communicate internationally have changed dramatically in recent years. The emergence of wireless international calling as well as VoIP have created substantial new communications pathways and vehicles for consumers. This paper extends the focus of traditional international demand studies to incorporate these new pathways for international communications. It draws upon a modern database that incorporates both mobile and VoIP calling made over the 2009–2012 period between 25 countries around the world. Among other things, it finds that modern consumers of international calling are most sensitive to mobile and VoIP telephone prices and that the deployment of broadband has replaced the deployment of fixed telephone lines as a key enabling infrastructure for international calling. The results suggest that future studies of international communications should certainly incorporate these features.

1. Introduction

Over the years a well-established body of research has developed on the demand for international telecommunications.[1] These studies have focused on the economic determinants of calls made across international boundaries using landline telephones and traditional circuit-switching technology (known as Time-Division Multiplexing or TDM). In recent years, however, consumers have increasingly used alternative technologies (e.g., Voice over Internet Protocol or VoIP) and alternative devices (e.g., mobile telephones) to communicate internationally.

The developments are significant. Differences in the volumes of international calling made using both VoIP and TDM and volumes for TDM-only calling are substantial. For instance, the Federal Communications Commission's International Telecommunications Data Report (2014), which does not include international VoIP traffic, reports a total of 77.9 billion minutes of outgoing international traffic from the United States in 2012, while more comprehensive data which include VoIP traffic reports 135.2 billion outgoing minutes from the United States.[2] This difference of 53.3 billion minutes indicates that much of the action in international calling has transitioned beyond traditional TDM calls. Given this substantial gap, it is impossible to fully understand the modern market for international calling services without accounting for international VoIP traffic. Indeed, failure to do so risks distortions to such important matters as demand forecasting, understanding current price trends, analyzing market competitiveness, and establishing and achieving efficient settlement rates (i.e., the price paid by the originating company to the receiving company to connect international calls).

Similarly, wireless telephony has experienced unprecedented growth in recent years. According to the International Telecommunications Union, by 2001 the number of wireless subscribers had surpassed the number of fixed-line subscribers worldwide and by 2013 had reached 6.6 billion.[3] While this fixed-to-mobile substitution has been increasingly well-documented in a domestic context,[4] the importance of mobile telephony has not been incorporated into studies of international telecommunications demand.

In light of these developments, the purpose of this paper is both to update and expand the economic analysis of international telecommunications demand. Our conceptual model accounts for call externalities[5] and employs a dynamic panel estimator to estimate the structure of international telecommunications demand. The empirical analysis employs a unique database that contains both wired and wireless TDM and VoIP-based international telephone calls between 25 countries over the 2009–2012 period.

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[1] This literature is reviewed in Section 2 below.

[2] The more comprehensive data, which we employ in our empirical analysis, have been developed by TeleGeography and are described in Section 3 below.

[3] See, http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

[4] See, e.g., Vogelsang (2010) and Macher (2014).

[5] Call externalities, or reciprocal effects, mean that the utility function of the consumer depends not only on the calls made, but also on the calls received since in both cases information is received.

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Several interesting findings emerge in the paper. First, the prices of telephone calls from fixed phones have no statistically significant impact on the demand for international calling, while the prices of calls from mobile phones and VoIP have a negative and significant impact on the demand for international telephone communications. Second, the responsiveness of international outgoing calls with respect to originating and return-call prices of mobile-to-mobile phone calling are quite low, −0.081 and −0.079, respectively. Given that mobile-to-mobile international calling is the most expensive option for international calling this result may seem counter-intuitive, but the low price sensitivity in all likelihood reflects the fact that mobile-to-mobile calling also affords connectivity beyond the nodal connections available from wired telephone networks. Third, the results suggest that the demand for outgoing international calls is quite responsive to the prices of VoIP calls in the partner country – the estimated elasticities equal to −14,272 for calls to fixed phones, and −3.414 for calls to mobile phones. This finding suggests that the most price-sensitive group of consumers are users of VoIP telephony who might be substituting calls to telephones with calls between computers or other VoIP-capable devices (such calls are free of charge). Finally, negative cross-price elasticities with respect to mobile and VoIP calls indicate that incoming and outgoing calls are complements, rather than substitutes.

Apart from price effects, we find that higher levels of fixed broadband adoption increase the demand for international communications. Second, the results show that higher volumes of trade and higher migration between countries increase the demand for international calls. Third, geographically close countries are found to have higher demand for country-pair communications. Finally, we find that fixed-line telephone proliferation does not appear to be significant in defining the volume of international telephone traffic.

The remainder of the paper is structured as follows. Section 2 provides a background discussion and frame the existing literature. Section 3 develops a conceptual and econometric model of international calling demand. Section 4 then discusses the data that are used for empirical estimation. Section 5 provides the statistical results; and Section 6 summarizes and concludes the paper.

2. Background and existing literature

International telephony has been especially impacted in recent years by two major developments. First, wireless telephone subscribership has exploded around the world. Fig. 1 shows the growth of fixed and mobile international telephone traffic over the 2008–2012 period. As is readily seen, while fixed-line international calling has remained virtually flat, the amount of international mobile traffic has grown dramatically. Over only the five-year period from 2008 to 2012, wireless international calling nearly doubled, growing from 131 billion minutes to over 252 billion minutes, a compound annual growth rate of 18%. This rapid growth in international mobile telephony has led to a substantial shift in the proportion of international calls across wireline and wireless telephony. Specifically, in 2008, only 34% of all international traffic was originated on wireless devices, yet by 2012 nearly 50% of all international originating traffic was wireless.

Second, the development of broadband (high-speed Internet) coupled with historically high rates for international calls via traditional circuit-switched networks has encouraged the use of an alternative technology for voice communications – VoIP telephony, which effectively converges the Internet and telephone technologies. VoIP allows users to make voice calls using a broadband Internet connection instead of a regular telephone line. Unlike TDM that establishes a dedicated circuit between the parties for voice transmission and cannot be used for another call until the originating call is concluded, VoIP relies on packet-switching, which divides the voice transmission into packets and sends them over the fastest available route. Packets may travel through completely different routes, however, the conversation is reassembled in the correct order before being passed on the VoIP application. Internet Protocol (IP) gateways serve as access points from the IP network to the PSTN (Public Switched Telephone Network). IP gateways also perform such functions as call termination, determination of call direction, user verification and billing. VoIP uses available bandwidth more efficiently than circuit-switched telephony and allows providers to maintain a single IP network for both voice and data.[6]

As a result of the bandwidth efficiency and low costs that VoIP technology can provide, consumers are migrating from traditional copper-wire telephone systems to VoIP systems to reduce expenditures for telephone calls. Also, VoIP offers some extra features that are attractive to the customers, such as conference calls, portability, and other business applications. A potential impediment for consumers to utilize VoIP technology, however, may be the limited availability of high-speed Internet. Specifically, because VoIP uses the Internet as a backbone, consumers need broadband access to conduct/receive high-quality calls via VoIP services. Consequently, the lack of high-speed Internet availability in some locations may create high switching costs from traditional circuit-switched telephony to VoIP.

In its infancy, the VoIP market was quite small and its quality was rather poor. Recent increases in broadband adoption and Internet performance (higher speeds) have, however, allowed more subscribers the opportunity to communicate using VoIP at a lower cost and more reliably. VoIP communications now are available through numerous devices: specialized VoIP telephones, regular telephones with a VoIP adapter, smartphones, tablets, and computers. Additionally, VoIP allows extra features that are not available through regular telephones, such as instant messaging, web conferencing and video calls.

Fig. 2 shows the evolution of international TDM and VoIP traffic over the 2008–2012 period. There it is seen that while a majority of international calling is TDM-based over this period, the share of TDM calls has been shrinking rapidly due both to the slow growth of originating TDM minutes and the very rapid growth of VoIP minutes. Over the five-year period, VoIP traffic doubled, growing from 93 billion minutes to 184 billion minutes.[7]

As the telecommunications industry has evolved, so too has the economic research on international telecommunications demand. Earlier works, e.g., Lago (1970), and Yatrakis (1972), Rea and Lage (1978) focused on the estimation of demand for international telecommunications services provided via the telephone, telegram and telex.[8] They also analyzed substitutability/complementarity of these three services. Bewley and Fiebig (1988) extend Lago's model by distinguishing between the demand for access and usage.

In an influential paper, Acton and Vogelsang (1992) propose a theoretical model of international telecommunications demand that accounts for both the presence of a call externality and arbitrage.[9] While identifying these potential important drivers of international calling demand patterns, Acton and Vogelsang do not incorporate them into their empirical analysis. Subsequent empirical

[6] See, Petition for Declaratory Ruling that AT&T's Phone-to-Phone IP Telephony Services are Exempt from Access Charges, WC Docket No. 02–361 (April 21, 2004). Available at http://www.jsitel.com/files/file_1213712102_r4857c6e633347.pdf.

[7] Note that this measure provides a conservative picture of VoIP growth as it does not include voice calls conducted from computer to computer. For example, traffic from Skype to Skype is not included.

[8] See Taylor (1994) for a cogent review.

[9] Call arbitrage occurs when consumers in the higher tariff country are more likely to receive than place telephone calls as consumers in a lower tariff country may initiate the conversation, lowering the total cost of the telephone call.